Composite of NASA JSC Photos by Mark Sowa

Photos clockwise from top, left: Robert Trevino and Joe Kosmo scope out the site of JSC's Remote Field Site Demonstration and Test Area; engineers use the simulated Mars field for an EVA power cable deployment task with assistance from the ATV Jr.; Dean Eppler and Joe Kosmo maneuver a boulder onto the site, and a 1965 photo depicts now retired NASA engineer Jack Slight maneuvering above the original JSC simulated lunar surface in a prototype Apollo spacesuit.

The dirt on Mars terrain

In the mid-'60s, NASA created a simulated lunar surface on the JSC site to help engineers conceptualize and design for missions to the moon. Now, more than 30 years later as NASA prepares to embark on new ground in the universe, engineers have created another simulated surface site – this one replicating Mars terrain.

NASA JSC Photo S65-22328

Tucked away in the far reaches of JSC's campus, a small 100-foot square area has been transformed from the grassy field so familiar in Southeast Texas, to what now appears as a quadrant of the Red Planet.

NASA engineers Joe Kosmo and Robert Trevino of the Crew and Thermal Systems Division, EVA and IVA Equipment Branch, spearheaded development of the Remote Field Site Demonstration and Test Area with Advanced Mobility Suit testing in mind. The design and capabilities of EVA suits will need to be vastly different for the purposes of extraterrestrial planetary surface exploration than they are for their current role in orbital operations.

Trevino uses our stroll through the site to illustrate his point.

"Normally we move in a straight line, but see what you are doing as you walk here?" asks Trevino. "You're having to look down to navigate around the rocks and obstacles. To accommodate for that, we have to design the spacesuit with that in mind. It will be very different from the current spacesuit. The purpose of this Mars field is to help us get into that environment so we can understand what the challenges and problems are."

"Planetary exploration is going to be a lot more challenging than orbital operations," adds Kosmo. "That is what we're trying to demonstrate here to the next generation of designers and engineers, the kind of conditions to contend with. It's going to be a challenge to develop equipment, procedures and the techniques to do the various operations for this new environment."

The project began in 1997 with a preliminary architectural study to determine the requirements for such a simulation. Kosmo and Trevino polled other organizations to gauge their interest or preferences and soon found the terrain could be of use to many teams, including designers for Mars rovers.

The result is now a terrain that can be used by many groups ranging from the Exploration Office to the Automation, Robotics and Simulation Division to other NASA centers and even private industry or universities.

The site was created by first scouting a suitable piece of land on the JSC campus. Developers sought a site that had characteristics that could easily be molded into the Mars landscape. The landscape was bulldozed, scraped of vegetation, and then covered with geo-fabric, a textile sheet that prohibits weed regrowth. The support of Center Operations engineers Steve Campbell and Melissa McKinley was invaluable to completing the project.

Moonlight lava, a basaltic volcanic rock from New Mexico, was positioned selectively upon the field of crushed decomposed granite to replicate the Red terrain. Kosmo and Trevino studied images from the Mars Pathfinder to determine the placement of the rocks.

"The rocks are distributed here to mimic the pattern from photos taken of Mars. We've simulated the natural environment," said Kosmo, "creating a microcosm of nature and representing it in a 100-foot by 100-foot area."

A casual observer might not notice at first glance, but all of the larger rocks are assembled close to one area. Gradually smaller rocks radiate from that area, and still smaller rocks are peppered through the remainder of the site. When asked about the placement, Kosmo and Trevino explained it is a pattern observed on Mars and also well recognized here on Earth. The theory is that as water flows, larger rocks are not moved much, but medium-sized rocks may get moved by the liquid some distance, and yet smaller rocks and sand can get carried away quite a distance.

NASA JSC Photo 2000-03852 by Mark Sowa

All in all, more than 20 tons of rock were used to create the terrain. A team of 13 volunteers held a "rock party" to break and position the rocks. They completed the task one Saturday morning – presenting JSC scientists and engineers with a Mars-like test bed.

Since the site's completion in May, engineering teams have already used the testbed. One team used the site to assess an inflatable-wheel rover vehicle.

"All they were able to use for testing before was climbing stairs," said Trevino. "This field gives them a real test environment to see if the vehicles can maneuver over rocks and obstacles."

Dr. Rob Burridge of S&K Electronics, project manager for the EVA Robotic Assistant, says the Mars terrain has already proven to be an asset for early design evaluations.

"The first time we took the rover out to the site, we found the robot could not maneuver around the terrain at all," said Burridge. His team redesigned the base of the robot to be better suited for the terrain. They've since used the site to test various sensors on the robot, including stereo vision, inertial measurement, and a laser rangefinder for tracking people.

"It was very valuable to be able to run over the uneven terrain, and see how the rocks showed up in the rangefinder. This will considerably speed development of our astronaut tracking algorithms," added Burridge, who expects to use the test site on a weekly basis.

According to Kosmo and Trevino the possibilities for the simulation site are endless.

"We have to start thinking about what we are going to need if we want to really start pursuing travel to Mars," said Kosmo. "This may include other test sites, and chambers to simulate the atmospheric environment. Our goals are ambitious and now is the time to start developing the various testing infrastructures needed to support future exploration efforts." ■